

REMARKS

Claims 1-20 are currently pending in the above-identified patent application. In the subject Office Action, the Examiner rejected claims 1, 6, 7, 8, and 17-20 under 35 U.S.C. § 102(b) as being anticipated by Lichte (U.S. Patent Number 5,303,585), since, the Examiner asserted that Lichte discloses a volume sensing system which includes electronic circuitry, which is electrically connected to an ultrasonic transducer which is affixed by means of an adaptor to the base of a container having a known configuration and holding a liquid and a gas so that a liquid-gas boundary is formed within the container. The transducer generates ultrasonic pulses which propagate through the liquid, which are reflected at the liquid-gas boundary, and are received again by the transducer. The received return pulse is converted into an electrical signal which is analyzed by the electronic circuitry to determine the level of the liquid within the container. The level of the liquid within the container is then employed to determine the volume of the liquid within the container in accordance with the configuration of the container. In a preferred embodiment, the adaptor includes an indicator which may be used to identify the configuration of the container

The Examiner continued by stating that in regard to claim 1, Lichte discloses and shows in figures 1 and 5 an apparatus for measuring liquid level in a container which comprises in combination: (a) a transducer (11) in physical contact with the outside of a wall of the container (120) located below the surface of the Liquid for generating at least two acoustic resonance responses in the Liquid substantially perpendicular to the surface (160 and 162); (b) a sweep generator (410 in Fig. 5) for electrically exciting said transducer over a chosen range of acoustical frequencies and having a chosen waveform, and (c) a receiver for measuring the acoustic frequencies for at least two resonant responses.

In reference to claim 20, the Examiner stated that Lichte discloses a method for measuring Liquid level in a container which comprises the steps of: (a) generating at least two acoustic resonances in the Liquid substantially parallel to the surface of the Liquid, and (b) detecting the presence of acoustic resonances from the Liquid.

Applicants respectfully disagree with the Examiner concerning these grounds of rejection for the reasons to be set forth hereinbelow. This analysis is also responsive to the rejection of claims 2-5 and 9-16 35 U.S.C. § 103(a) as being unpatentable over Lichte, since the Examiner's assertion that the apparatus of Lichte generates acoustic resonances is a common theme throughout the grounds of rejection of the present Office Action.

Reexamination and reconsideration are respectfully requested.

Briefly, the present invention includes an acoustic-based, frequency domain apparatus and method for liquid level detection. The term acoustic is considered to include both low-frequency sound waves and ultrasonic sound waves (that is, sound waves ≥ 20 kHz). In the apparatus of the present invention, standing waves are generated in an acoustic cavity formed by the surface of the liquid acting as a reflector and a transducer for introducing vibrational energy into the liquid external to and through a wall of the container holding the liquid. The standing waves are detected using a transducer either located nearby to, or collocated with the energy transmitting transducer, or by the energy transmitting transducer itself, and the response of the system is measured as a function of frequency.

The apparatus includes a transducer in physical contact with the outside of a wall of said container located below the surface of the liquid for generating at least two acoustic resonance responses in the liquid substantially perpendicular to the surface; a sweep generator for electrically exciting the transducer over a chosen range of acoustical frequencies with a chosen waveform; and a receiver for determining the frequencies of the at least two resonant responses.

In another aspect of the present invention, the apparatus for measuring liquid level in a container hereof includes a transducer in physical contact with the outside of a wall of the container located below the surface of the liquid for generating acoustic resonance responses in the liquid substantially parallel to the surface; a generator for electrically exciting said transducer; and a receiver for detecting the presence of resonant responses from the liquid.

By contrast, as is stated in Col. 10, lines 38-44, of Lichte, device 410 is a 3 MHz oscillator. This fixed frequency oscillator does not provide a sweep of the

transducer frequencies over the resonance responses in the liquid. Rather, as is stated in Col. 11, line 53 to Col. 12, line 2 of Lichte: "The output of amplifier **440** is shown as the electrical pulse **510** (FIG. 6c) which is applied to the line **447**. This output pulse **510** is transmitted to the transducer **110** where the electrical pulse **510** causes the crystal within the transducer **110** to vibrate at the same frequency as the signal **510** (i.e., 3 MHz). The vibration of the crystal causes the ultrasonic pulse **160** to propagate through the liquid **130** as describe above with reference to FIG. 1. When the reflected "echo" pulse **162** returns, the crystal once again is caused to vibrate and produces an electrical signal pulse **512** with the same frequency as the pulse **162** on the line **447** at the input of the recover amplifier **445**. Thus, the time at which the electrical pulse **510** is generated is substantially simultaneous with the generation of ultrasonic pulse **160**, and the time at which the electrical pulse **512** is generated is substantially simultaneous with the reception of the ultrasonic pulse **162**."

Thus, Lichte does not teach the generation of frequencies which are swept over the resonance response in the liquid, nor does it render obvious this concept. Applicants therefore, respectfully believe that the Examiner is incorrect in the rejection of claims 1, 6, 7, 8, and 17-20 under 35 U.S.C. § 102(b) as being anticipated by Lichte (U.S. Patent Number 5,303,585), and in the rejection of claims 2-5 and 9-16 35 U.S.C. § 103(a) as being unpatentable over Lichte.

For these reasons, applicants believe that claims 1-20, as originally filed, are in condition for allowance, and such action by the Examiner at an early date being earnestly solicited. Reexamination and reconsideration are respectfully requested.

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Respectfully submitted,

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